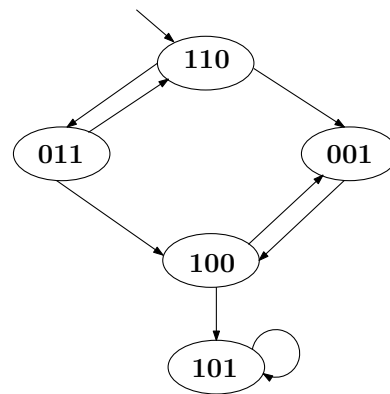# SAT solvers and Model Checking

Formal Systems

The diagram above shows a transition system where each state is labelled with a three bit binary number. State 110 is the initial state. Other transitions are shown with directed edges between the states. Using the SAT solver zChaff implement the following questions:

1. Model the transition system in zChaff. Model the three bit binary numbers with variables - x_1, x_2 and x_3 where x_1 is the most significant bit and x_3 is the least significant bit.

2. Using BMC (Bounded Model Checking) method find out all the states those are reachable in 2 unrollings. Note that, SAT gives only one state as a solution in each run.

   [Hint: Multiple SAT instances are required to find all the reachable states. In each iteration, add the negation of the already found states.]

3. Check the safety property: $G\neg(x_1 \wedge x_2 \wedge x_3)$.

4. Check the liveness property: $GF\neg x_3$.